

Preface

Integral processes with dead time are frequently encountered in engineering. Typical examples include tanks, where the level is controlled by manipulating the difference between the input and output flow rates, batch distillation columns, data communication networks, and supply chain management processes. Because they are not asymptotically stable (namely, they are not self-regulating), their control requires special attention, and for this reason, many control techniques have been proposed for this purpose. In particular, different approaches have been exploited to design PID controllers, which are by far the most widely adopted controllers in industry. However, it is recognised that in the presence of a large time delay in the process and of tight control requirements, a single degree-of-freedom PID controller may not suffice to obtain the desired performance. Indeed, in the last fifteen years, starting with the paper by Åström, Hang, and Lim in 1994, the research in the control of integral processes with dead time has become very active, mainly motivated by the fact that the well-known Smith predictor fails to provide a null steady-state error in the presence of a constant load disturbance. In this context, many two-degree-of-freedom schemes have been proposed, and their analysis and design have been discussed in a wide literature.

This book presents some of these techniques by fully characterising them from both academic and industrial points of view and highlighting the peculiarities of each of them. The control schemes and the procedures for the selection of the parameters are outlined clearly, and illustrative examples are presented in order to evaluate the rationale of each method and the performance achievable.

The book is divided into two parts: PID Control Schemes (Chapters 2 to 5) and Two-degree-of-freedom Control Schemes (Chapters 6 to 12). In the first part, the tuning of a PID controller and the determination of its stabilising region are addressed, in addition to a technique for the performance assessment (and retuning) of a PID controller and for the Plug&Control strategy. In the second part, different methodologies for the design of two-degree-of-freedom control schemes are presented, in particular those based on the Smith predictor concept. The achievable performance is quantitatively analysed, and some practical issues are dealt with.

The book can serve as a reference for postgraduate students and academic researchers. It will also help industrial practitioners solve their control problems by

selecting the most suitable technique and by achieving the best cost/benefit ratio. Readers are assumed to know the fundamentals of linear control systems, which are typically acquired in a basic course in automatic control at the university level.

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